CLAIMS

What is claimed is:

1. A mechanism for positioning and orienting an end component in space with at least five degrees of freedom, the mechanism comprising:

a base;

a first actuator limb comprising at least a platform connected to said base by a revolute joint allowing one rotational degree of freedom about a central axis, a first limb member movably connected to said platform with a single actuated degree of freedom relative to said platform, and a second limb member movably connected to said first limb member, said second limb member having at least three degrees of freedom relative to said base, wherein at least one of said degrees of freedom of said second limb member is actuatable relative to said base;

at least second, third, fourth, and fifth actuator limbs, each of the actuator limbs comprising at least an actuator arm rotatably connected to said base by an actuated revolute joint allowing rotation about a respective actuator axis, each of said second, third, fourth, and fifth actuator limbs further comprising a forearm movably connected to said actuator arm of the respective actuator limb, wherein said forearm has at least three degrees of freedom relative to said actuator arm including one free rotational degree of freedom about a respective forearm axis;

a first joint body, wherein said second limb member is rotatably connected to said first joint body and allowed to rotate relative to said first joint body about a first joint axis, and wherein each of the forearms of said second and third actuator limbs is rotatably connected to said first joint body and allowed to rotate relative to said first joint body about a respective second and third joint axis which is non-parallel to said forearm axis of the respective actuator limb;

a second joint body, wherein each of the forearms of said fourth and fifth actuator limbs is rotatably connected to said second joint body and allowed to rotate relative to said second joint body about a respective fourth and fifth joint axis which is non-parallel to said forearm axis of the respective actuator limb; and

said end component movably connected to each of said first and second joint bodies, the end component having at least two rotational degrees of freedom relative to each of said first and second joint bodies such that said end component is movable with at least five degrees of freedom relative to said base.

2. A mechanism according to claim 1, wherein the actuator axis of each of said second and third actuator limbs is substantially coincident with said central axis.

3. A mechanism according to claim 1, wherein the actuator axis of each of said fourth and fifth actuator limbs is substantially parallel to said central axis.

4. A mechanism according to claim 1, wherein the actuator axis of each of said fourth and fifth actuator limbs is substantially coincident with said central axis.

5. A mechanism according to claim 1, wherein said second and third joint axes are substantially parallel to each other and perpendicular to said first joint axis.

6. A mechanism according to claim 1, wherein said second and third joint axes are substantially coincident and perpendicular to said first joint axis and wherein said first, second and third joint axes and the forearm axes of said second and third actuator limbs pass through a first common point.

7. A mechanism according to claim 1, wherein said fourth and fifth joint axes are substantially parallel to each other.

8. A mechanism according to claim 1, wherein said fourth and fifth joint axes are substantially coincident and wherein said fourth and fifth joint axes and the forearm axes of said fourth and fifth actuator limbs pass through a second common point.

9. A mechanism according to claim 1, wherein said first limb member is connected to said platform by an actuated revolute joint allowing rotation about a primary axis, and said second limb member is connected to said first limb member by a revolute joint allowing rotation about a secondary axis, and wherein said

primary axis, said secondary axis, and said first joint axis are substantially parallel to each other and perpendicular to said central axis.

10. A mechanism according to claim 1, wherein said end component is connected to said first joint body by a first and a second revolute joint in series allowing rotation about respective first and second revolute axes, and wherein said end component is connected to said second joint body by a third and a fourth revolute joint in series allowing rotation about respective third and fourth revolute axes.

11. A mechanism according to claim 10, wherein said first revolute axis is substantially coincident with said first joint axis, and wherein said second revolute axis is perpendicular to said first revolute axis and intersects said first revolute axis and said central axis, and wherein said fourth revolute axis is perpendicular to said third revolute axis and intersects said third revolute axis.

12. A mechanism according to claim 1, wherein said forearm and said actuator arm of at least one of said second, third, fourth, and fifth actuator limbs are connected by three revolute joints in series, said revolute joints having mutually non-parallel and intersecting axes of rotation.

13. A mechanism according to claim 1, wherein said forearm and said actuator arm of at least one of said second, third, fourth, and fifth actuator limbs are connected by a ball-and-socket joint.

14. A mechanism according to claim 1, further comprising a work tool movably mounted to said end component for actuatable movement relative thereto.

15. A mechanism according to claim 14, further comprising an actuator mounted to said base and operably linked to said work tool, said actuator driving said work tool to move relative to said end component.

16. A mechanism according to claim 14, further comprising an actuator mounted to said end component and operably linked to said work tool, said actuator driving said work tool to move relative to said end component.

17. A mechanism according to claim 1, wherein the forearm of each of said second and third actuator limbs is connected to the respective actuator arm with three rotational degrees of freedom about a connection point, and wherein the connection points of said second and third actuator limbs substantially move in the same plane.

18. A mechanism according to claim 1, wherein said second limb member is connected to said first joint body by a revolute joint allowing rotation about said first joint axis, and wherein the forearms of said second and third actuator limbs are connected to said first joint body by respective revolute joints allowing rotation about said second and third joint axes, and wherein the forearms of said fourth and fifth actuator limbs are connected to said second joint body by respective revolute joints allowing rotation about said fourth and fifth joint axes.

19. A mechanism according to claim 1, further comprising influencing means, said influencing means urging said platform to be rotated about said central axis by at least one of the actuator arms of said second and third actuator limbs.

20. A mechanism according to claim 1, further comprising influencing means, said influencing means urging said platform to rotate about said central axis such that the actuator arms of said second and third actuator limbs remain at substantially equal angular distance from said first limb member.

21. A mechanism according to claim 20, wherein said influencing means comprise:

a guiding arm rotatably connected to said platform by a revolute joint allowing one rotational degree of freedom; and

a first and a second influencing arm pivotably connected to the actuator arm of a respective one of said second and third actuator limbs by first influencing joints allowing at least two rotational degrees of freedom, each of said first and second influencing arms further being pivotably connected to said guiding arm by second influencing joints allowing at least two rotational degrees of freedom.

22. A mechanism according to claim 21, wherein at least one of said first and second influencing joints is a ball-and-socket joint.

23. A mechanism according to claim 21, wherein at least one of said first and second influencing joints is a universal joint.

24. A mechanism according to claim 20, wherein said influencing means comprise:

a first guiding arm rotatably connected to said platform by a revolute joint allowing one rotational degree of freedom;

a second guiding arm rotatably connected to said first guiding arm by a revolute joint allowing one rotational degree of freedom; and

a first and a second influencing arm connected to the actuator arm of a respective one of said second and third actuator limbs by respective revolute joints allowing one rotational degree of freedom, each of said first and second influencing arms further being pivotably connected to said second guiding arm by universal joints allowing two degrees of freedom.

25. A mechanism for positioning and orienting an end component in space with at least three degrees of freedom, the mechanism comprising:

a base;

a first actuator limb comprising at least a platform connected to said base by a revolute joint allowing one rotational degree of freedom about a central axis, a first limb member movably connected to said platform with a single actuated degree of freedom relative to said platform, and a second limb member movably connected to said first limb member, said second limb member having at least three degrees of freedom relative to said base, wherein at least one of said degrees of freedom of said second limb member is actuatable relative to said base;

at least second and third actuator limbs, each of the actuator limbs comprising at least an actuator arm rotatably connected to said base by an actuated revolute joint allowing rotation about a respective actuator axis, each of said second and third actuator limbs further comprising an upper and a lower forearm movably connected to said actuator arm of the respective actuator limb, wherein each of said upper and lower forearms has at least three degrees of freedom relative to said

actuator arm including one free rotational degree of freedom about a respective upper and lower forearm axis;

a first joint body, wherein said second limb member is connected to said first joint body by a revolute joint allowing rotation about a first joint axis, and wherein each of the upper forearms of said second and third actuator limbs is connected to said first joint body by a revolute joint allowing rotation about a respective second and third joint axis which is non-parallel to said upper forearm axis of the respective actuator limb;

a second joint body, wherein each of the lower forearms of said second and third actuator limbs is connected to said second joint body by a revolute joint allowing rotation about a respective fourth and fifth joint axis which is non-parallel to said lower forearm axis of the respective actuator limb; and

said end component movably connected to each of said first and second joint bodies, the end component having at least one rotational degree of freedom relative to each of said first and second joint bodies such that said end component is movable with at least three degrees of freedom relative to said base.

26. A mechanism according to claim 25, wherein the actuator axis of each of said second and third actuator limbs is substantially coincident with said central axis, and wherein each of the upper forearms of said second and third actuator limbs is connected to the respective actuator arm with three rotational degrees of freedom about a respective first connection point, and wherein each of the lower forearms of said second and third actuator limbs is connected to the respective actuator arm with three rotational degrees of freedom about a respective second connection point, and wherein said first connection points move in a first plane and said second connection points move in a second plane substantially parallel to said first plane.

27. A mechanism according to claim 25, wherein said second and third joint axes are substantially parallel to each other and perpendicular to said first joint axis, and wherein said fourth and fifth joint axes are substantially parallel to each other.

28. A mechanism according to claim 25, wherein said first, second and third joint axes and the upper forearm axes of said second and third actuator limbs pass through a first common point, and wherein said fourth and fifth joint axes and the lower forearm axes of said second and third actuator limbs pass through a second common point.

29. A mechanism according to claim 25, wherein said first limb member is connected to said platform by an actuated revolute joint allowing rotation about a primary axis, and said second limb member is connected to said first limb member by a revolute joint allowing rotation about a secondary axis, and wherein said primary axis, said secondary axis, and said first joint axis are substantially parallel to each other and perpendicular to said central axis.

30. A mechanism according to claim 25, wherein said end component is connected to said first joint body by a revolute joint allowing rotation about a first revolute axis, and wherein said end component is connected to said second joint body by a revolute joint allowing rotation about a second revolute axis, wherein said first and second revolute axes and said first joint axis are parallel to each other.

31. A mechanism according to claim 25, wherein said end component is connected to said first joint body by a revolute joint allowing rotation about a first revolute axis, and wherein said end component is connected to said second joint body by a revolute joint allowing rotation about a second revolute axis, wherein said first and second revolute axes are parallel to each other and wherein said first revolute axis coincides with said first joint axis.

32. A mechanism according to claim 25, wherein each of said upper and lower forearm of at least one of said second and third actuator limbs is connected to said actuator arm by three revolute joints in series, said revolute joints having mutually non-parallel and intersecting axes of rotation.

33. A mechanism according to claim 25, wherein at least one of said second and third actuator limbs further comprises a common link connected to said actuator arm by a first revolute joint, and wherein said common link is connected to each of said upper and lower forearms by a second and third revolute joint in series,

said first revolute joint and respective second and third revolute joints having mutually non-parallel and intersecting axes of rotation.

34. A mechanism according to claim 25, wherein each of said upper and lower forearm of at least one of said second and third actuator limbs is connected to said actuator arm by a ball-and-socket joint.

35. A mechanism according to claim 25, further comprising a work tool movably mounted to said end component for actuatable movement relative thereto.

36. A mechanism according to claim 35, further comprising an actuator mounted to said base and operably linked to said work tool, said actuator driving said work tool to move relative to said end component.

37. A mechanism according to claim 35, further comprising an actuator mounted to said end component and operably linked to said work tool, said actuator driving said work tool to move relative to said end component.

38. A mechanism according to claim 25, further comprising influencing means, said influencing means urging said platform to rotate about said central axis such that the actuator arms of said second and third actuator limbs remain at substantially equal angular distance from said first limb member.